Interface methods for meso-scale models of porous materials

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Numerical modelling of many processes is done at the so-called macro-scale, due to the prohibitive computational expense of resolving material heterogeneity. At the macro-scale, heterogeneous or granular materials are approximated as isotropic, homogeneous materials, with a single equation of state and strength model, and processes on the granular scale (such as pore collapse or slip between grains) must be parameterised (by a porosity model and/or damage model).

Meso-scale modelling of porous/granular/rock materials is simulation at a scale where grains/pores/heterogeneities (and the interfaces between them) are represented explicitly. Such models are typically used to (a) provide insight into grain/pore-scale processes that are difficult to observe experimentally, and (b) build parameterisations of bulk behaviour for use in macro-scale simulations. For example, Borg & Vogler (2008) performed 2D numerical meso-scale simulations of the planar compaction of a granular powder to determine its response to shock compression and to assess the feasibility of using the results to construct the bulk material behaviour.

The behaviour of granular materials in meso-scale simulations (and hence the realism of the simulation) depends sensitively on how the interfaces between grains are treated. This project will explore alternative strategies for interface treatment in meso-scale simulations. Interface methods that are employed in hydrocodes developed by AWE and Imperial will be tested. The sensitivity of model results to these techniques will be used to inform future development. Improved or novel interface treatments will be developed. Results of meso-scale simulations will be used to build better parameterisations for strong porous materials in macro-scale simulations of impact processes and processes of interest to AWE.

References:

Borg JP & Vogler TJ, Mesoscale calculations of the dynamic behavior of a granular ceramic, *International Journal of Solids and Structures* **45**, 1676–1696 (2008).